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ORIGINAL RESEARCH

Comparison of Performance Achievement Award Recognition With Primary Stroke Center Certification for Acute Ischemic Stroke Care

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***Background*—**Hospital certification and recognition programs represent 2 independent but commonly used systems to distinguish hospitals, yet they have not been directly compared. This study assessed acute ischemic stroke quality of care measure conformity by hospitals receiving Primary Stroke Center (PSC) certification and those receiving the American Heart Association's Get With The Guidelines-Stroke (GWTG-Stroke) Performance Achievement Award (PAA) recognition.

***Methods and Results*—**The patient and hospital characteristics as well as performance/quality measures for acute ischemic stroke from 1356 hospitals participating in the GWTG-Stroke Program 2010–2012 were compared. Hospitals were classified as PAA+/PSC+ (hospitals n=410, patients n=169 302), PAA+/PSC− (n=415, n=129 454), PAA−/PSC+ (n=88, n=26 386), and PAA−/PSC− (n=443, n=75 565). A comprehensive set of stroke measures were compared with adjustment for patient and hospital characteristics. Patient characteristics were similar by PAA and PSC status but PAA−/PSC− hospitals were more likely to be smaller and nonteaching. Measure conformity was highest for PAA+/PSC+ and PAA+/PSC− hospitals, intermediate for PAA−/PSC+ hospitals, and lowest for PAA−/PSC− hospitals (all-or-none care measure 91.2%, 91.2%, 84.3%, and 76.9%, respectively). After adjustment for patient and hospital characteristics, PAA+/PSC+, PAA+/PSC−, and PAA−/PSC+ hospitals had 3.15 (95% CIs 2.86 to 3.47); 3.23 (2.93 to 3.56) and 1.72 (1.47 to 2.00), higher odds for providing all indicated stroke performance measures to patients compared with PAA−/PSC− hospitals.

***Conclusions*—**While both PSC certification and GWTG-Stroke PAA recognition identified hospitals providing higher conformity with care measures for patients hospitalized with acute ischemic stroke, PAA recognition was a more robust identifier of hospitals with better performance. **(*J Am Heart Assoc.* 2013;2:e000451 doi: 10.1161/JAHA.113.000451)**

Key Words: acute stroke • measures registry • Primary Stroke Center certification

Stroke is the fourth leading cause of death and a leading cause of disability in the United States.[1] While evidence-based guidelines for acute stroke care have been developed along with improved diagnostic and treatment modalities,[2,3] there are gaps, variations, and disparities in how these are applied that are not fully explained by clinical factors.[4–6] Hospitals also differ in the structural aspects of stroke care, including the systems responsible for the provision of care, the material resources on which those systems depend, and the organizational structures that guide the interactions.[7] All of these differences can affect stroke care quality.

Hospital certification, accreditation, and recognition programs are playing an increasingly important role in health care, including acute ischemic stroke care.[7] These programs are being used as a basis for determining a wide variety of different care delivery policies and practices, including which centers emergency medical services transport patients to, value-based purchasing, preferred contracting, hospital profiling, and advertising.[7] Hospital certification and accreditation programs, including The Joint Commission/American Heart Association (AHA) Primary Stroke Center (PSC) certification program, generally involve structural components and standard-setting, analytical, and self-improvement dimensions.[7–10] However, most hospital certification and accreditation programs do not have a requirement for achieving a certain level of performance in processes or outcomes for a center to

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initially obtain, maintain, or renew certification or accreditation.[7–10] In contrast, hospital recognition programs, including the AHA's Get With The Guidelines-Stroke (GWTG-Stroke) Performance Achievement Award (PAA) recognition program, are usually based on meeting certain performance levels on standardized evidence-based measures.[6,7,11,12] These programs recognize hospitals that demonstrate excellence or improvement in performance, including process measures, outcome measures, safety measures, and/or efficacy measures.[7,12,13]

Although several prior studies have described the quality of stroke care associated with hospital certification and accreditation programs and that associated with hospital recognition programs,[7,14–20] to the best of our knowledge, no prior study has compared the care provided for patients with acute ischemic stroke as a function of hospital certification and hospital recognition using standardized process of care assessment measures. Because of its size, national scope, duration, and prospective collection of evidence-based, guideline directed process of care measures, the GWTG-Stroke Program provides an opportunity to compare care provided by hospitals with PSC certification and those with GWTG-Stroke PAA recognition.[12] It is also ideally suited for this purpose because nearly all PSC hospitals use the GWTG-Stroke data collection system to participate in the PSC program, thereby minimizing any confounding due to different data platforms, performance measurement systems, or bias due to missing sites or data. The main objective of this study was to compare evidence-based, guideline-directed stroke care measures provided by GWTG-Stroke–participating hospitals with both PAA recognition and PSC certification, PAA recognition without PSC certification, PSC certification without PAA recognition, and neither PAA recognition or PSC certification. We hypothesized that among GWTG-Stroke–participating hospitals, that PAA recognition would be a better identifier of hospitals with higher level of conformity to these stroke measures than PSC certification.

Methods

GWTG-Stroke is an ongoing voluntary, continuous registry and performance improvement initiative that collects patient level data on characteristics, diagnostic testing, treatments, adherence to quality measures, and in-hospital outcomes in patients hospitalized with stroke. Details of the design and conduct of the GWTG-Stroke Program have been previously described.[11,12] GWTG-Stroke uses a Web-based Patient Management Tool (Outcome, a Quintiles Company) to collect clinical data, provide decision support, and real-time online reporting features. The GWTG-Stroke Program was made available in April 2003 to any hospital in the United States.[11,12] Trained hospital personnel are instructed to ascertain consecutive patients admitted with acute ischemic stroke by either prospective clinical identification, retrospective identification using *International Classification of Diseases* (ICD)-9 discharge codes, or a combination.[11,12] ICD-9 codes used to identify ischemic stroke hospitalizations included 433.x, 434.x, and 436 and the eligibility of each acute ischemic stroke admission was confirmed at chart review before abstraction. Additional descriptions of the case ascertainment, data collection, and quality auditing methods have been previously published.[11,12,21]

Each participating hospital received either human research approval to enroll cases without individual patient consent under the common rule, or a waiver of authorization and exemption from subsequent review by their institutional review board. Outcome, a Quintiles Company, serves as the data collection and coordination center for GWTG. The Duke Clinical Research Institute serves as the data analysis center and has an agreement to analyze the aggregate deidentified data for research purposes.

Patient Population

Among all acute ischemic stroke admissions or transfers from hospitals that participated in the program between January 1, 2010 and April 2, 2012 (510 184 hospitalizations from 1628 hospitals), we excluded 93 267 (18.3%) transfer-in cases, 13 812 (2.7%) cases and 49 hospitals that provided incomplete medical history data, and 2398 (0.47%) cases and 218 hospitals because <30 acute ischemic stroke patients were entered during the study period. The final analysis sample consisted of 400 707 acute ischemic stroke admissions from 1356 hospitals.

Hospital Classification

The GWTG-Stroke PAA recognition program was created and used to publicly recognize participating hospitals meeting each of the 7 individual GWTG-Stroke performance measures (described later) in 85% of eligible hospitalizations for ≥1 year.[6,11,12] Hospitals that obtained or maintained award status during the study period were classified as having PAA recognition. Hospitals THAT were listed by The Joint Commission as having maintained or obtained The Joint Commission/AHA PSC certification during the study period were classified as having PSC certification.[22] While there are a small number of hospitals that have pursued an alternative PSC certification by other organizations,[7] such certification was not used to classify hospitals in this study. Data on hospital-level characteristics (ie, bed size, academic or nonacademic status, annual volume of stroke discharges, and geographical region) were obtained from the American Hospital Association database.[23]

Stroke Measure Definitions

The GWTG-Stroke Program developed a set of process-based performance measures to quantify the quality of care for acute ischemic stroke patients. In 2007, the AHA/American Stroke Association came to an agreement with The Joint Commission's PSC certification program and the Centers for Disease Control and Prevention Coverdell Registry to jointly release a set of standardized stroke performance measures for use by all 3 programs.[12,13] These performance measures have been endorsed by the National Quality Forum, and the detailed measure specifications were previously published.[12] The following 7 performance measures selected as primary targets for stroke quality improvement efforts in GWTG-Stroke and used as the basis for the GWTG-Stroke PAA recognition program.[11,12]

Acute Performance Measures

- Intravenous recombinant tissue-type plasminogen activator (IV TPA) in patients who arrive within 2 hours after symptom onset and are treated within 3 hours of symptom onset (IV TPA 2 h/3 h)
- Antithrombotic medication (antiplatelet or anticoagulant) prescribed within 48 hours of admission (early antithrombotics)
- Deep venous thrombosis (DVT) prophylaxis (warfarin, heparin, low-molecular-weight heparin, other anticoagulant, pneumatic compression devices) within 48 hours of admission in patients at risk for DVT (nonambulatory) (DVT prophylaxis)

Discharge Performance Measures

- Antithrombotic medication (antiplatelet or anticoagulant) prescribed at discharge (antithrombotics)
- Anticoagulation prescribed at discharge in patients with documented atrial fibrillation (anticoagulation for atrial fibrillation)
- Statin medication prescribed at discharge if LDL ≥ 100 mg/dL, if patient treated with lipid-lowering agent before admission, or if LDL is not documented (LDL 100 or ND)
- Smoking cessation intervention (counseling or medication) at discharge for current or recent smokers (smoking cessation)

The following 9 additional measures, referred to as GWTG-Stroke quality measures by the program, have also been used to quantify the processes of care provided to patients enrolled in GWTG-Stroke as previously described.[12,13]

Additional Stroke Measures

- IV TPA) in patients who arrive within 3 hours after symptom onset and are treated within 4.5 hours of symptom onset (IV TPA 3 h/4.5 h)
- Door-to-brain imaging (BI) time ≤25 minutes in patients presenting with stroke symptoms <3 hours' duration (DTBI ≤25 minutes)
- Door-to-needle time ≤60 minutes for patients treated with IV TPA (DTN ≤60 minutes)
- LDL levels measured (LDL measured)
- Intensive statin therapy prescribed at discharge (specific agent and doses of statin therapy) with intensive lipid-lowering effects in patients with stroke of atherosclerotic origin (intensive statin)
- Weight loss counseling provided to patients with body mass index (BMI) ≥25 kg/m^2 (weight loss counseling)
- Dysphagia screening before any oral intake (dysphagia screening)
- Stroke education provided to patient and/or caregiver, all 5 components: modifiable risk factors, stroke warning sign and symptoms, how to activate emergency medical services, need for follow-up, medications prescribed (stroke education)
- Patient was assessed for and/or received stroke rehabilitation services (stroke rehabilitation)

Performance and other process of care measures are applied only to eligible patients in the absence of documented contraindications or any other rationale as to why therapy was not provided. Two different measures were used to summarize the overall conformity with acute and discharge performance measures for each hospital.[11,12] An all-or-none measure of care (also termed defect-free care) was used, which is defined as the proportion of patients who received *all* of the 7 performance measure interventions for which they were eligible. A composite measure of care, defined as the total number of 7 performance measure interventions performed among eligible patients *divided by* the total number of possible performance measure interventions among eligible patients, was also calculated.

Statistical Analysis

The patient characteristics, hospital characteristics, and measures of care for acute ischemic stroke were compared among 4 groups of hospitals: hospitals with both PAA recognition and PSC certification (PAA+/PSC+), hospitals with PAA recognition without PSC certification (PAA+/PSC−), hospitals with PSC certification without PAA recognition (PAA−/PSC+), and hospitals with neither PAA recognition nor PSC certification (PAA−/PSC−). Percentages and median (25th and 75th percentiles) were reported to describe distribution of the patient and hospital characteristics, including patient demographic, clinical variables, and hospital-level characteristics. Pearson χ^2 tests and Kruskal–Wallis tests were used to compare categorical and

continuous/ordinal variables, respectively. Conformity with performance measures, summary measures, and other process of care measures were also compared among the patients treated in the 4 groups of hospitals with Kruskal–Wallis tests. Multivariable logistic regression models were performed to further examine the relationship between PAA/PSC hospital type and care measures with PAA−/PSC− hospitals used as the reference group. To account for within-hospital clustering, generalized estimating equations were used to generate both unadjusted and adjusted models. The following prespecified patient characteristics variables were included in the multivariable models: age, sex, race, on or off hour arrival time (holiday or before 7 AM/after 6 PM on Monday to Friday), and past medical history of atrial fibrillation, previous stroke/transient ischemic attack, coronary heart disease or prior myocardial infarction, carotid stenosis, diabetes, peripheral vascular disease, hypertension, dyslipidemia, heart failure, and current smoking.[11,12] Furthermore, multivariable models were performed to adjust for hospital characteristics including hospital size (number of beds), geographical region, teaching status, annual ischemic stroke volume, and annual IV TPA volume. As stroke severity, as quantified by the National Institute of Health Stroke Score (NIHSS) may influence the stroke care provided, but was not documented in all patients, we conducted sensitivity analyses by repeating the analyses in the subgroup of patients with NIHSS documented and adjusting for NIHSS along with patient and hospital characteristics.

All statistical analyses were performed using SAS Version 9.2 software (SAS Institute). All *P* values were 2-sided, with $P<0.05$ considered statistically significant. The authors had full access to the data and take responsibility for its integrity. All authors have read and agree to the manuscript as written.

Results

There were 400 707 acute ischemic stroke admissions from 1356 hospitals entered into the GWTG-Stroke registry that met the study criteria. Hospitals were classified as having both PAA recognition and PSC certification (PAA+/PSC+; hospitals N=410, patients n=169 302), PAA recognition without PSC certification (PAA+/PSC−; N=415, n=129 454), PSC certification without PAA recognition (PAA−/PSC+; N=88, n=26 386), and neither PAA recognition nor PSC certification (PAA−/PSC−; N=443, n=75 565). In this cohort, the mean age was 70.3±14.4 years and 50.9% were women.

Table 1 compares the patient demographic and clinical characteristics by hospital groups. The age and sex of acute ischemic stroke patients showed little difference between the 4 hospital categories. Hospitals that were PPA recognized but not PSC certified were slightly more likely to care for black and Hispanic patients. Hospitals that were PSC certified, whether PAA recognized or not, admitted patients with shorter onset to arrival times, but off hour arrivals were similar among the hospital groups. Comorbid conditions generally occurred with similar frequency among admissions at the 4 hospital groups. Stroke severity by NIHSS was a median value of 4 in each hospital group, although hospitals with neither PPA recognition nor PSC certification documented NIHSS much less frequently. The vital signs, body mass index, creatinine levels, and LDL levels were similar among the hospital groups.

Hospital characteristics are shown in Table 2. Hospitals without both PAA recognition and PSC certification had fewer beds and lower annual volume of stroke patients. Hospitals with PAA recognition were more likely to be teaching institutions compared with nonrecognized hospitals, regardless of PSC status. Annual rates of IV TPA use differed substantially by PSC and PAA status, with the greatest volume in hospitals with PAA recognition and PSC certification and the lowest volume in those hospitals with neither recognition nor certification. There were some differences in geographic distribution. There were more hospitals in the Northeast with PAA recognition but without PSC certification and more hospitals in the Midwest with PSC certifications but without PAA recognition.

Performance measures conformity is shown in Table 3 and the Figure. Conformity with each individual performance measure was highest for hospitals that were PAA recognized regardless of whether PSC certified. Performance measure conformity was intermediate for hospitals with PSC certification without PAA recognition, and quality was lowest for hospitals with neither PAA recognition nor PSC certification. The largest differences in performance measures were for IV TPA administration in patients arriving within 2 hours and treated with 3 hours, where PAA-recognized hospitals, with or without PSC certification, provided TPA treatment to 88% to 89% of eligible patients, whereas PSC-certified hospitals without PAA recognition treated only 64% of eligible patients and those hospitals without recognition or certification treated only 48% ($P<0.0001$). Measures for DVT prophylaxis, statin treatment for LDL ≥100 mg/dL, and anticoagulation for atrial fibrillation showed the same pattern but with more moderately sized differences. Smaller, but still statistically significant, differences were observed for early and discharge antithrombotics as well as smoking cessation counseling. The all-or-none summary care measure was 91.2%, 91.2%, 84.3%, and 76.9% for PAA+/PSC+, PAA+/PSC−, PAA−/PSC+, and PAA−/PSC− hospitals, respectively (Table 3).

Conformity with additional stroke measures is also shown in Table 3. The individual care measures were highest for PPA-recognized hospitals whether PSC certified or not, intermediate for hospitals with PSC certification without PAA recognition, and lowest for hospitals with neither PAA recognition nor PSC certification. The timeliness of TPA treatment was better in PAA-recognized hospitals with DTN times within 60 minutes

Table 1. Patient Characteristics by Hospital PAA Recognition and PSC Certification Status

Variable	Level	PAA+/PSC+ (N=410) (n=169 302)	PAA+/PSC− (N=415) (n=129 454)	PAA−/PSC+ (N=88) (n=26 386)	PAA−/PSC− (N=443) (n=75 565)	*P* Value*
Demographics						
Age	Median, y (IQR)	72 (60 to 82)	72 (60 to 82)	71 (60 to 82)	72 (60 to 82)	<0.0001
Sex	Women	50.52	51.09	50.99	51.45	<0.0001
Race/ethnicity	White	70.52	65.58	71.67	67.83	<0.0001
	Asian	2.94	3.00	2.30	2.53	
	Black	16.01	19.67	15.93	17.74	
	Hispanic	6.62	7.76	6.64	7.75	
Presentation						
Arrival mode	EMS transport	49.92	50.80	46.16	42.97	<0.0001
Arrived at off hours	Yes	49.41	49.36	49.45	48.04	<0.0001
Time from symptom onset to arrival	Median, min (IQR)	180 (64 to 571)	205 (67 to 622)	179 (63 to 545)	215 (70 to 642)	<0.0001
NIHSS	Median (IQR)	4 (2 to 10)	4 (2 to 9)	4 (1 to 9)	4 (1 to 9)	<0.0001
NIHSS documented	Yes	67.79	67.20	67.52	46.20	<0.0001
Medical history						
Atrial fibrillation/ flutter	Yes	17.19	16.55	16.64	15.73	<0.0001
Prosthetic heart valve	Yes	1.33	1.30	1.48	1.15	<0.0001
Previous stroke/TIA	Yes	29.80	29.71	31.72	30.73	<0.0001
CAD/prior MI	Yes	25.35	24.73	27.62	25.72	<0.0001
Carotid stenosis	Yes	4.10	3.64	4.93	4.38	<0.0001
Diabetes mellitus	Yes	31.69	33.03	33.59	33.93	<0.0001
PVD	Yes	4.77	4.25	5.32	4.87	<0.0001
Hypertension	Yes	75.49	76.33	76.17	76.43	<0.0001
Smoker	Yes	18.56	18.63	20.09	19.49	<0.0001
Dyslipidemia	Yes	44.04	42.09	43.58	42.37	<0.0001
Heart failure	Yes	8.08	7.80	9.27	8.26	<0.0001
Vital signs and labs						
Heart rate	Median, bpm (IQR)	79 (68 to 91)	79 (69 to 91)	78 (68 to 91)	79 (68 to 91)	<0.0001
Systolic blood pressure	Median, mm Hg (IQR)	155 (137 to 178)	155 (137 to 178)	155 (137 to 178)	155 (137 to 178)	0.5488
Body mass index	Median, kg/m^2 (IQR)	27.0 (23.6 to 31.3)	27.0 (23.6 to 31.3)	27.2 (23.5 to 31.5)	27.3 (23.7 to 31.6)	<0.0001
Creatinine	Median, mg/dL (IQR)	1.0 (0.8 to 1.3)	1.0 (0.8 to 1.3)	1.0 (0.8 to 1.3)	1.0 (0.8 to 1.3)	<0.0001
LDL	Median, mg/dL (IQR)	97 (73 to 125)	98 (75 to 126)	98 (74 to 126)	99 (75 to 127)	<0.0001

N shows number of hospitals and n shows number of acute ischemic stroke patients. CAD indicates coronary heart disease; EMS, emergency medical services; IQR, interquartile range; MI, myocardial infarction; NIHSS, National Institutes of Health Stroke Score; PAA, Performance Achievement Award; PSC, Primary Stroke Center; PVD, peripheral vascular disease; TIA, transient ischemic attack.

**P*-values are based on Pearson χ^2 tests for all categorical row variables or based on χ^2 rank-based group means score statistics for all continuous/ordinal row variables (equivalent to Kruskal–Wallis test) indicating if there are differences in at least 1 hospital group.

Table 2. Hospital Characteristics by PAA Recognition and PSC Certification Status

Variable	Level	PAA+/PSC+		PAA+/PSC−		PAA−/PSC+		PAA−/PSC−		*P* Value*
		n=410	%	n=415	%	n=88	%	n=443	%	
Number of beds	Median	408	338	411	265	82	306	386	211	<0.0001
	25th		233		177		198		128	
	75th		463		401		396		326	
Annual IS patients	301+	149	36.34	101	24.34	22	25.00	33	7.45	<0.0001
	101 to 300	213	51.95	195	46.99	48	54.55	198	44.70	
	0 to 100	48	11.71	119	28.67	18	20.45	212	47.86	
Annual IV TPA cases	Median	410	13.33	415	6.22	88	7.38	443	2.40	<0.0001
	25th		7.50		3.11		3.53		0.50	
	75th		22.67		13.33		14.44		5.78	
Annual IV TPA cases (categorized)	>10	126	30.73	58	13.98	12	13.64	11	2.48	<0.0001
	>6 to ≤10	131	31.95	85	20.48	24	27.27	42	9.48	
	≤6	153	37.32	272	65.54	52	59.09	390	88.04	
Region	West	96	23.41	66	15.90	12	13.64	94	21.22	<0.0001
	South	156	38.05	140	33.73	31	35.23	147	33.18	
	Midwest	88	21.46	48	11.57	37	42.05	114	25.73	
	Northeast	70	17.07	161	38.80	8	9.09	88	19.86	
Hospital type teaching	Yes	211	51.46	201	48.43	34	38.64	148	33.41	0.0007

The n values shows number of hospitals. IS indicates ischemic stroke; IV, intravenous; PAA, Performance Achievement Award; PSC, Primary Stroke Center; TPA, tissue-type plasminogen activator. *P-values are based on Pearson χ^2 tests for all categorical row variables or based on χ^2 rank-based group means score statistics for all continuous/ordinal row variables (equivalent to Kruskal–Wallis test), indicating if there are differences in at least 1 hospital group.

achieved in 33.9% and 32.8% of patients, whereas this benchmark was achieved in only 22.0% of patients in PSC-certified hospitals without PAA recognition and in 25.1% in hospitals without PAA recognition or PSC certification (P<0.0001). The treatment with TPA in the expanded time-frame of arrive within 3.5 hours and treat within 4.5 hours was also substantially greater in PAA-recognized hospitals (67.7% and 63.9%) than in PSC-certified hospitals without PAA recognition (50.0%) and hospitals that were neither PAA recognized nor PSC certified (35.8%; P<0.0001). The other stroke measures showed a similar pattern (Table 3).

The multivariable analyses results are shown in Tables 4 and 5. After these adjustments, the odds for measure conformity were significantly greater at hospitals with PAA recognition regardless of PSC certification status compared with hospitals without PAA recognition and PSC certification for each individual measure. After adjustment for patient and hospital characteristics, PAA+/PSC+, PAA+/PSC−, and PAA−/PSC+ hospitals had 3.15 (95% CI 2.86 to 3.47); 3.23 (2.93 to 3.56), and 1.72 (1.47 to 2.00) higher odds for providing all indicated stroke performance metrics to patients compared with PAA−/PSC− hospitals. When performance of PAA-recognized hospitals with PSC certification was compared with PAA-recognized hospitals without PSC certification, there were no significant differences (all-or-none summary performance measure adjusted odds ratio 1.02 [0.93 to 1.14], P=0.5935 for PAA+/PSC+ hospitals with PAA+/PSC− as reference). In contrast, performance of PAA-recognized hospitals without PSC certification was superior to hospitals with PSC certification but without PAA recognition (adjusted odds ratio 1.71 [1.45 to 2.02], P<0.0001 for PAA+/PSC− hospitals with PAA−/PSC+ as reference).

In sensitivity analyses, performed in the subgroup of patients with NIHSS documented, and risk-adjusting for patient characteristics, NIHSS, and hospital characteristics produced similar findings for performance measures and quality measures to those presented in Tables 4 and 5 (data not shown). The adjusted odds ratios of the all-or-none summary performance measure conformity were 2.91 (2.62 to 3.23) for PAA-recognized and PSC-certified hospitals; 2.90 (2.62 to 3.21) for PAA-recognized but not PSC-certified hospitals; and 1.48 (1.26 to 1.74) for PSC-certified but not PAA-recognized hospitals, with hospitals with neither PAA recognition nor PSC certification as reference.

Discussion

Providing standardized, objective, unbiased assessment of hospital performance in cardiovascular disease and stroke care may help to ensure quality patient care, patient safety, and

Table 3. Stroke Measure Conformity by Hospital PAA Recognition and PSC Certification Status

Variable	PAA+/PSC+ n=169 302	%	PAA+/PSC− n=129 454	%	PAA−/PSC+ n=26 386	%	PAA−/PSC− n=75 565	%	*P* Value* (PAA+/PSC+ vs PAA−/PSC−)	*P* Value* (PAA+/PSC− vs PAA−/PSC−)	*P*-Value* (PAA−/PSC+ vs PAA−/PSC−)	*P* Value* (PAA+/PSC+ vs PAA+/PSC−)	*P* Value* (PAA+/PSC− vs PAA−/PSC+)
Acute performance measures, %													
IV TPA arrived by 2 hours and used to treat by 3 hours	12 905	88.76	8868	88.02	1893	63.97	5583	47.91	<0.0001	<0.0001	<0.0001	0.097	<0.0001
Early antithrombotics	97 698	97.43	78 045	97.72	15 980	96.41	47 334	95.11	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
DVT prophylaxis	67 574	94.83	51 372	94.98	9015	90.42	24 280	86.12	<0.0001	<0.0001	<0.0001	0.239	<0.0001
Discharge performance measures, %													
Antithrombotics	139 909	99.02	106 875	98.91	21 903	97.69	63 034	97.12	<0.0001	<0.0001	<0.0001	0.010	<0.0001
Anticoagulant for AF	21 305	96.58	15 523	96.40	3308	91.38	9349	86.89	<0.0001	<0.0001	<0.0001	0.342	<0.0001
Statin LDL 100 or ND	92 938	93.87	72 162	93.87	14 658	89.68	45 421	83.63	<0.0001	<0.0001	<0.0001	0.995	<0.0001
Smoking cessation	27 182	98.34	20 761	98.25	4514	96.96	12 621	93.44	<0.0001	<0.0001	<0.0001	0.453	<0.0001
Summary of performance measures													
All-or-none measure, %	155 086	91.22	118 748	91.22	24 219	84.31	69 691	76.87	<0.0001	<0.0001	<0.0001	0.998	<0.0001
Composite measure, mean	155 086	96.61	118 748	96.64	24 219	93.82	69 691	90.68	<0.0001	<0.0001	<0.0001	0.969	<0.0001
Additional stroke measures, %													
IV TPA arrived by 3 hours and used to treat by 4.5 hours	20 717	67.65	14 994	63.94	3240	49.97	9816	35.78	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Door to BI ≤25 minutes	34 696	51.71	24 811	51.36	5070	50.54	12 828	45.19	<0.0001	<0.0001	<0.0001	0.407	0.237
DTN time ≤60 minutes	14 642	33.93	10 111	32.82	1725	21.97	3856	25.05	<0.0001	<0.0001	0.0129	0.068	<0.0001
Dysphagia screen	145 764	85.86	111 592	83.68	22 962	78.85	67 089	62.95	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
LDL testing	146 382	91.63	112 009	90.39	22 791	87.02	65 105	81.47	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Intensive statin therapy	55 436	25.72	41 952	29.41	8326	22.82	23 649	19.63	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Weight loss counseling	64 836	64.28	50 124	58.60	9168	56.92	27 299	43.16	<0.0001	<0.0001	<0.0001	<0.0001	0.003
Stroke education	82 449	92.14	64 391	88.93	12 837	85.90	38 988	70.49	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Stroke rehabilitation	143 140	98.26	109 314	97.65	22 333	96.15	64 203	93.21	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Numbers shown represent patients eligible for each measure. AF indicates atrial fibrillation; BI, brain imaging; DTN, door-to-needle time; DVT, deep vein prophylaxis; IV, intravenous; ND, not documented; PAA, Performance Achievement Award; PSC, Primary Stroke Center; TPA, tissue-type plasminogen activator.

*P values are based on Pearson χ^2 tests for all categorical row variables. All tests treat the column variable as nominal. See Methods section for each stroke measure and summary measures definitions.

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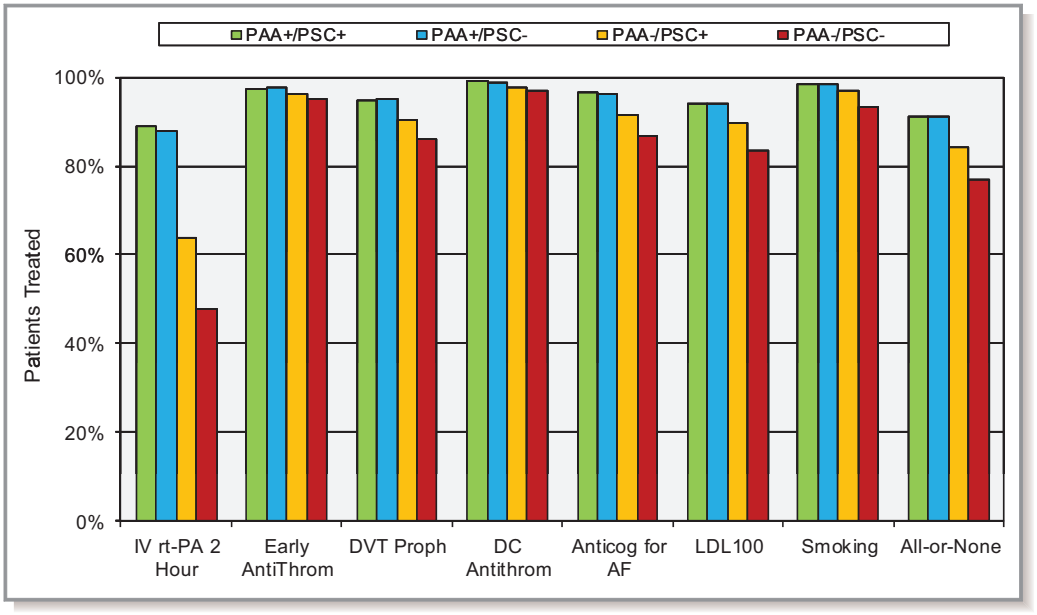

Figure. Performance measure conformity by hospital PAA recognition and PSC certification status. *P*-value is <0.0001 for each individual performance measure and the summary all-or-none measure for each pairwise comparison, except for the comparisons between PAA+/PSC+ vs PAA+/PSC− hospitals. All-or-none measure represents the proportion of patients who received all of the measures that they were eligible for. AF indicates atrial fibrillation; Anticoag, anticoagulation; antithrom, antithrombotics; DC, discharge; DVT, deep vein prophylaxis; IV, intravenous; PAA, Performance Achievement Award; proph, prophylaxis; PSC, Primary Stroke Center; t-PA, tissue-type plasminogen activator (TPA).

favorable outcomes.[7] As hospital certification, accreditation, and recognition programs may provide highly visible distinctions for hospitals and influence where cardiovascular and stroke patients are transported and treated, it is important that they accurately identify hospitals that achieve high standards of performance in cardiovascular disease and stroke care.[7] In this study, evidence-based, guideline-directed measures of acute ischemic stroke care associated with The Joint Commission PSC hospital certification program and the AHA/American Stroke Association GWTG-Stroke PAA recognition program were compared. We found that while both the GWTG-Stroke PAA recognition program and the PSC certification program identified hospitals with higher measure conformity in patients hospitalized with acute ischemic stroke, PAA recognition was more strongly associated with higher measure conformity than PSC certification. Even after extensive adjustment for patient and other hospital characteristics, the overall pattern of care assessed by standard measures as a function of hospital recognition and certification persisted. These findings may have important implications in guiding the evolution of hospital certification, accreditation, and recognition programs and stroke systems of care.

To improve the care of stroke patients, The Joint Commission in conjunction with the AHA established the PSC certification program.[7,9,10] A PSC is a facility that is recognized by The Joint Commission as providing evidence-based care for patients with an acute cerebrovascular event.[7] In 2003, The Joint Commission began certifying PSC based on recommendations from the Brain Attack Coalition and the AHA.[9,10] Certification is granted if a facility demonstrates compliance with national standards, PSC recommendations, clinical practice guidelines, and performance measurement and improvement activities.[7] However, The Joint Commission PSC certification program, despite stating the PSC-certified centers "demonstrate their application of and compliance with clinical practice guidelines published by the AHA/American Stroke Association or equivalent evidence-based guidelines," does not have a requirement that a certain level of performance in processes or outcomes be achieved or maintained for a center to be certified.[7,24] Information which reflects the impact that PSC certification has had on quality has been sparse because of limited availability of data from hospitals prior to their becoming a PSC.[7,16,24] A recent study has shown higher rates of use of TPA in hospitals that are PSC certified compared with noncertified hospitals.[18] In addition, some studies have suggested patients treated at PSC hospitals have better outcomes,[17,19] although 1 study found PSC hospitals had better outcomes prior to going through the certification process.[16] In the present study, hospitals with PSC certification without PAA recognition, provided TPA to eligible patients at lower rates in both the 3-hour and 4.5-hour time-frame compared with hospitals with PAA recognition. Further, the proportion of patients with DTN times for IV TPA within 60 minutes was lowest in these PSC-certified–only hospitals. For identifying hospitals providing timely treatment with TPA, providing TPA treatment to a greater proportion of

Table 4. Performance Measure Conformity by Hospital PAA Recognition and PSC Certification Status: Unadjusted and Adjusted ORs

Performance Measures	Hospital Status (Reference PAA−/PSC−)	Unadjusted			Adjusted for Patient Factors*			Adjusted for Patient and Hospital Factors†		
		OR	Lower 95% CI	Upper 95% CI	OR	Lower 95% CI	Upper 95% CI	OR	Lower 95% CI	Upper 95% CI
IV TPA arrived by 2 hours and used to treat by 3 hours	PAA+/PSC+	8.55	7.30	10.02	8.52	7.27	9.99	5.62	4.80	6.59
	PAA+/PSC−	8.02	6.79	9.47	8.01	6.78	9.46	6.34	5.37	7.47
	PAA−/PSC+	1.96	1.55	2.48	1.95	1.54	2.46	1.53	1.21	1.93
Early antithrombotic agent	PAA+/PSC+	2.11	1.84	2.41	2.06	1.80	2.35	2.26	1.95	2.62
	PAA+/PSC−	2.47	2.16	2.82	2.49	2.16	2.87	2.50	2.15	2.90
	PAA−/PSC+	1.46	1.20	1.79	1.44	1.18	1.76	1.57	1.27	1.94
DVT prophylaxis	PAA+/PSC+	3.34	2.95	3.79	3.35	2.95	3.81	2.89	2.52	3.31
	PAA+/PSC−	3.37	2.95	3.85	3.38	2.95	3.88	3.01	2.63	3.46
	PAA−/PSC+	1.56	1.25	1.95	1.58	1.27	1.98	1.50	1.20	1.87
Antithrombotic agent at discharge	PAA+/PSC+	3.16	2.72	3.66	2.99	2.55	3.51	2.73	2.31	3.22
	PAA+/PSC−	2.84	2.40	3.36	2.82	2.35	3.38	2.60	2.14	3.14
	PAA−/PSC+	1.41	1.07	1.86	1.40	1.06	1.83	1.34	1.02	1.75
Anticoagulation for atrial fibrillation	PAA+/PSC+	4.48	3.81	5.26	4.35	3.70	5.12	3.51	2.94	4.20
	PAA+/PSC−	4.37	3.67	5.20	4.41	3.71	5.25	3.76	3.15	4.51
	PAA−/PSC+	1.74	1.37	2.20	1.71	1.35	2.17	1.55	1.22	1.96
Statin for LDL>100 mg/dL or not documented	PAA+/PSC+	3.23	2.93	3.56	3.13	2.82	3.49	2.58	2.31	2.89
	PAA+/PSC−	3.07	2.77	3.41	3.16	2.81	3.55	2.77	2.47	3.11
	PAA−/PSC+	1.75	1.47	2.08	1.74	1.47	2.07	1.61	1.36	1.90
Smoking cessation counseling	PAA+/PSC+	4.39	3.46	5.59	4.40	3.46	5.60	3.91	2.92	5.23
	PAA+/PSC−	4.11	3.14	5.37	4.16	3.18	5.45	3.88	2.89	5.21
	PAA−/PSC+	1.99	1.37	2.91	1.99	1.36	2.91	1.78	1.20	2.63
All-or-none measure	PAA+/PSC+	3.48	3.20	3.79	3.52	3.22	3.84	3.15	2.86	3.47
	PAA+/PSC−	3.46	3.15	3.79	3.54	3.21	3.90	3.23	2.93	3.56
	PAA−/PSC+	1.75	1.51	2.03	1.78	1.53	2.08	1.72	1.47	2.00

CAD indicates coronary heart disease; DVT, deep venous thrombosis; IV, intravenous; MI, myocardial infarction; OR, odds ratio; PAA, Performance Achievement Award; PSC, Primary Stroke Center; PVD, peripheral vascular disease; TIA, transient ischemic attack; TPA, tissue-type plasminogen activator.

*Adjusted for age, sex, race, medical history of atrial fibrillation/flutter, prosthetic heart valve, previous stroke/TIA, CAD/prior MI, carotid stenosis, diabetes, PVD, hypertension, smoking, dyslipidemia, and heart failure, arrived at off-hours (holiday or before 7 AM/after 6 PM on Monday to Friday).

†Adjusted for patient characteristics and hospital characteristics of region, number of beds, teaching status, annual ischemic stroke volume, and annual IV TPA treatment volume.

time-eligible patients with acute ischemic stroke, and for conformity with the full set of stroke measures used in this study, GWTG-Stroke PAA recognition appeared to be a more reliable indicator than PSC certification.

The GWTG program was developed by the AHA/American Stroke Association as national registries and performance improvement programs for acute myocardial infarction, heart failure, and stroke with the primary goal of improving the quality of care and outcomes for cardiovascular disease and stroke.[6,7,11,12] A prior analysis of GWTG-Stroke data suggested improvements in care associated with time of exposure to the program, independent of changes in patient characteristics, hospital characteristics, or secular trend.[11] GWTG-Stroke has used a PAA recognition program for hospitals since inception.[6,7,12] A prior study compared hospitals enrolled in GWTG and receiving achievement awards for high levels of recommended processes of care with other hospitals, suggesting higher quality of care and better outcomes for acute myocardial infarction and heart failure patients, and the better outcomes were explained, at least in part, by better process of care provided by these recognized hospitals.[20] In the current study, PAA-recognized hospitals, with or without PSC certification, consistently provided care with higher measure conformity compared with hospitals without PAA recognition, with or without PSC certification. This included stroke measures that were not

Table 5. Additional Stroke Measure Conformity by Hospital PAA Recognition and PSC Certification Status: Unadjusted and Adjusted ORs

Stroke Measures	Hospital Status (Reference PAA−/PSC−)	Unadjusted			Adjusted for Patient Factors*			Adjusted for Patient and Hospital Factors†		
		OR	Lower 95% CI	Upper 95% CI	OR	Lower 95% CI	Upper 95% CI	OR	Lower 95% CI	Upper 95% CI
IV TPA arrived by 3.5 hours and used to treat by 4.5 hours	PAA+/PSC+	4.59	3.93	5.36	4.56	3.90	5.33	2.83	2.43	3.31
	PAA+/PSC−	3.45	2.95	4.03	3.41	2.91	3.99	2.73	2.34	3.19
	PAA−/PSC+	2.12	1.67	2.70	2.08	1.64	2.63	1.56	1.24	1.97
Door-to-brain imaging within 25 minutes	PAA+/PSC+	1.35	1.20	1.51	1.34	1.19	1.51	1.23	1.09	1.40
	PAA+/PSC−	1.34	1.19	1.50	1.34	1.19	1.50	1.29	1.14	1.45
	PAA−/PSC+	1.26	1.04	1.52	1.26	1.05	1.52	1.19	0.99	1.44
Door-to-needle time within 60 minutes	PAA+/PSC+	1.45	1.25	1.68	1.47	1.27	1.71	1.08	0.93	1.26
	PAA+/PSC−	1.38	1.19	1.59	1.39	1.20	1.62	1.18	1.02	1.37
	PAA−/PSC+	0.79	0.60	1.03	0.78	0.59	1.03	0.68	0.53	0.87
Dysphagia screening	PAA+/PSC+	4.06	3.56	4.62	4.00	3.51	4.57	3.49	3.01	4.05
	PAA+/PSC−	3.27	2.83	3.78	3.29	2.84	3.80	3.00	2.57	3.50
	PAA−/PSC+	2.92	2.36	3.62	2.91	2.34	3.62	2.62	2.10	3.27
LDL documented	PAA+/PSC+	3.10	2.78	3.45	3.20	2.85	3.59	2.61	2.30	2.95
	PAA+/PSC−	2.40	2.12	2.71	2.47	2.17	2.81	2.21	1.95	2.51
	PAA−/PSC+	1.81	1.50	2.19	1.89	1.53	2.35	1.63	1.31	2.02
Intensive statin therapy	PAA+/PSC+	1.54	1.31	1.80	1.70	1.47	1.97	1.50	1.27	1.76
	PAA+/PSC−	1.72	1.46	2.03	1.66	1.43	1.94	1.51	1.29	1.77
	PAA−/PSC+	1.30	0.99	1.69	1.37	1.06	1.77	1.36	1.04	1.77
Weight loss counseling for BMI $\geq$25 kg/m^2	PAA+/PSC+	2.25	1.83	2.77	2.27	1.84	2.80	2.13	1.68	2.70
	PAA+/PSC−	2.08	1.69	2.56	2.05	1.67	2.52	1.94	1.56	2.41
	PAA−/PSC+	1.58	1.14	2.18	1.52	1.10	2.11	1.55	1.11	2.16
Stroke education	PAA+/PSC+	6.16	5.26	7.22	5.95	5.09	6.96	4.81	4.06	5.71
	PAA+/PSC−	3.70	3.09	4.42	3.65	3.05	4.36	3.18	2.63	3.84
	PAA−/PSC+	3.15	2.47	4.01	2.82	2.16	3.67	2.47	1.89	3.22
Stroke rehabilitation	PAA+/PSC+	4.63	3.97	5.39	4.69	3.97	5.53	3.73	3.12	4.46
	PAA+/PSC−	3.11	2.69	3.59	3.08	2.64	3.60	2.79	2.38	3.26
	PAA−/PSC+	2.25	1.73	2.92	2.13	1.54	2.96	1.83	1.33	2.52

BMI indicates body mass index; CAD, coronary heart disease; IV, intravenous; MI, myocardial infarction; OR, odds ratio; PAA, Performance Achievement Award; PSC, Primary Stroke Center; PVD, peripheral vascular disease; TIA, transient ischemic attack; TPA, tissue-type plasminogen activator.

*Adjusted for age, sex, race, medical history of atrial fibrillation/flutter, prosthetic heart valve, previous stroke/TIA, CAD/prior MI, carotid stenosis, diabetes, PVD, hypertension, smoking, dyslipidemia, and heart failure, arrived at off-hours (holiday or before 7 AM/after 6 PM on Monday to Friday).

†Adjusted for patient characteristics and hospital characteristics of region, number of beds, teaching status, annual ischemic stroke volume, and annual IV TPA treatment volume.

part of the PAA award criteria, suggesting that this recognition program is able to identify hospital with superior performance in additional domains of acute ischemic stroke patient care.

There are a number of potential reasons for why there are differences in measure conformity by hospital recognition and certification status that remain following adjustment for baseline patient differences and other hospital characteristics. This may reflect that these programs accurately identify hospitals that are already providing higher performance in multiple domains of acute ischemic stroke patient care. In this way, the programs are effectively distinguishing performance levels among hospitals. Alternatively, these programs may facilitate performance improvement efforts allowing certain hospitals to elevate care above that of other hospitals.[11,24,25] Another possible explanation is that these differences are due to residual confounding by other unmeasured factors such as prestroke functional status. Given the minimal differences in measured patient characteristics among the hospitals and the consistency of the findings across multiple measures with and

without adjustment, this is unlikely. Less frequent use of evidence-based care may also be the choice of the patient or family or may be a reflection of physician-related factors.[12] However, when documented, such patients are excluded from the measure denominators.

The existing accreditation, recognition, and certification programs focus on either structural elements, process of care, or outcome measures in various combinations.[7] To comprehensively improve quality and outcomes for stroke, a more optimal approach may be a system that evaluates multiple aspects simultaneously.[7,24,26] The systems, processes, and outcome improvement infrastructure overlaps, and hence there may be economies of scale to assess quality more comprehensively.[7] While the current program for certification of PSC of The Joint Commission may do an excellent job of assessing the resources, protocols, and infrastructure of candidate hospitals, the program should potentially go further in documenting that quality care is being provided.[10,24] These findings suggest that to better support an accountable system of stroke care, PSC certifications programs should consider requiring hospitals to achieve a prespecified level of achievement in stroke performance measures, adopting similar requirements to the GWTG-Stroke PAA recognition program, to remain certified.[24] Alternatively, PSC certification programs could add a requirement for GWTG-Stroke participation with PAA recognition as part of the certification requirements. This combined approach has recently been adopted for The Joint Commission Advanced Certification Program in heart failure, which requires GWTG-Heart Failure PAA recognition as part of the certification program requirements.

This study does have several limitations. The GWTG-Stroke program is voluntary and the self-selected hospitals that participate are more likely to be larger teaching hospitals with an interest in stroke and quality improvement.[12,27] Data were self-reported by participating hospitals without external validation, although prior random quality audits of GWTG-Stroke data show high concordance rates with source documentation.[21] As all hospitals in this study were participating in GWTG-Stroke, it cannot be discerned whether GWTG-Stroke participation is necessary to meet high-level process adherence. Only 88 (17.7%) of 498 PSC-certified hospitals did not have PAA recognition. Residual measured and unmeasured confounding may influence the results of the multivariable analyses. It was not possible to account for stroke severity in all patients since the NIHSS is not documented for all patients in the database, and so NIHSS inclusion in the sensitivity analyses may have introduced selection bias. We were not able to analyze whether longer duration of PSC certification was associated with differences in performance/quality measure conformity. Because of the large sample size, some results may be statistically significant but not clinically meaningful. We analyzed care using only 7 predefined performance measures (which are used to determine PAA recognition and for which at least 85% conformity for each measure was expected) and 9 additional process measures that address acute and discharge care for acute ischemic stroke.[13] Conformity with these measures does not necessarily indicate better quality of care in general or translate directly into better clinical outcomes. Other measures to access care quality were not assessed, including other process measures, functional outcomes, procedure complications, health status, patient satisfaction, preventable readmissions, and risk-standardized mortality and these could produce different findings. Finally, only in-hospital care was assessed so differences in postdischarge care and patient-centered clinical outcomes were not determined. Additional studies should be performed with access the relationship between hospital recognition and certification with clinical outcomes.

Conclusions

Using data collected as part of the GWTG-Stroke, this study has characterized the care provided as indexed by a set of evidence-based, guideline-directed process measures for acute ischemic stroke patients among hospitals with and without GWTG-Stroke PAA recognition and The Joint Commission PSC certification. Measure conformity was highest for PPA-recognized hospitals, irrespective of PSC certification status, intermediate for hospitals with PSC certification without PAA recognition, and lowest for hospitals without certification and recognition. While both PSC certification and GWTG-Stroke PAA recognition identified hospitals providing greater care measure conformity in acute ischemic stroke, PAA recognition was a more reliable identifier of hospitals with better performance.

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